

	Type	L #	Hits	Search Text	DBs	Time Stamp
1	BRS	L1	22938	(die or dice) near8 (wafer or substrate)	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2003/08/01 18:09
2	BRS	L2	181	(bond near2 pad) same (test near2 pad)	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2003/08/01 18:11
3	BRS	L3	86	1 and 2	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2003/08/01 18:11

US-PAT-NO:

5554940

DOCUMENT-IDENTIFIER: US 5554940 A

TITLE: Bumped semiconductor device and  
method for probing the  
same

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Detailed Description Text - DETX (2):

The present invention enables bumped semiconductor die to be probed using conventional cantilever probe needles arranged in a peripheral configuration. In accordance with the present invention, a peripheral bond pad configuration is transformed into a C4 array configuration while maintaining peripheral testing capability. This may be achieved by forming peripheral bond pads on a semiconductor die so that the die may be used for those devices which are to be configured into a wire bond or TAB bond configuration, while also being able to be used for C4 devices. For those devices which are to be bumped (e.g. C4 devices), additional processing involves depositing an insulating layer over the die and the bond pads, and forming vias in the insulating layer to expose a portion of each bond pad. A redistribution metallization layer is then deposited and patterned over the insulating layer. The patterning creates a redistribution structure associated with each underlying bond pad. Each redistribution structure includes a test pad which is electrically connected through the via to an underlying bond pad, a C4 bump pad, and an interconnect portion which connects the test pad to the C4 bump pad. The test pad

associated with each bond pad is formed such that it is positioned at or near the same position as the underlying bond pad, although above it. As a result, all the test pads of the device are in a peripheral configuration much like the underlying bond pad configuration. On the other hand, the C4 bumped pads are formed in an array configuration displaced from the die periphery. The test pad of each bond pad is connected to a corresponding C4 bump pad through a metal interconnect portion. Because the test pads are formed with the same metallization layer as that used to form necessary C4 bumped pads, no additional processing steps are necessary in practicing the present invention as compared to conventional processes used to form C4 devices. Another significant advantage of the present invention is that not only can cantilever probe needles in a peripheral configuration be used to probe the semiconductor die, but in many cases the same probe card and cantilever probe configuration used to probe wire bonded or TAB bonded die with peripheral bond pads can be used to probe the peripherally located test pads with only a small modification of a bumped semiconductor die in accordance with the present invention.

**Detailed Description Text - DETX (9):**

After formation of vias 24, a redistribution metal layer is deposited over insulating layer 22 and into vias 24 to establish electrical connection to the bond pads. In a preferred embodiment, the metal layer deposited over insulating layer 22 is of the same material used to form bond pads 12, for example aluminum or an aluminum alloy, although other metals are also suitable. Conventional deposition techniques, such as sputtering, chemical vapor deposition, or the like may be used to deposit this metal

layer. The metal layer is subsequently patterned to form a plurality of redistribution structures 26, wherein an individual redistribution structure is formed to correspond with each underlying bond pad. FIGS. 6 and 7 illustrate redistribution structures 26 formed as a result of patterning the redistribution metallization layer. As FIG. 6 illustrates, each redistribution structure 26 is a continuous conductive element having at least three individual components: a test pad 28, a bump pad 30, and a bump pad interconnect 32 which electrically connects each test pad to its corresponding bump pad. As FIG. 6 also illustrates, a redistribution structure may also include a via pad 34 and/or a test pad interconnect 36 which are used to electrically connect a test pad 28 to an underlying bond pad 12. Via pad 34 and test pad interconnect 36 are not necessary, since the test pad can be directly formed around the via to establish electrical connection to the bond pad.

Detailed Description Text - DETX (10):

In accordance with the present invention, test pads 28 are formed in positions similar to those of the underlying bond pads. Ideally, the test pad positions are as close to the bond pad positions as possible so that the same probe card and cantilever probe needle configuration can be used to probe both wire bonded or TAB bonded devices as well as C4 or bumped devices. The position of bump pads 30 is unrestricted with the exception of design and layout rules a manufacturer might impose upon itself. However, it is noted that the bump should lie sufficiently spaced from the test pad in order to avoid interference with the probe when contacting the test

pad (as will subsequently become apparent below). The bump pad 30 may be formed directly overlying a bond pad 12 (as illustrated in the upper left portion of FIG. 6), or a bump pad may be formed closer to the center of die 10 (as also illustrated in FIG. 6). Advantages for forming bump pads 30 as close to the bond pads and test pads as possible is to reduce or minimize the length of the bump pad interconnect 32, thereby enhancing performance of the device. It is also important to note, however, that the bump should be sufficiently spaced from the test pad in order to avoid interference with a probe needle when contacting the test pad during programming. As FIG. 6 also illustrates, the size of test pads 28 need not be identical to those of underlying bond pads 12. The size of test pads 28 should be sufficiently large to enable adequate probing of the pads, but need not be as large as bond pads 12 since a wire bond or TAB bond will not be formed to the test pad. As an example, a typical bond pad 12 may be on the order of 5 mils (0.125 mm) square, while a test pad in accordance with an embodiment of the present invention may be on the order of 3.6 to 4.0 mils (0.09-0.10 mm) square. Note that bump pads 30 are patterned to be hexagonal. This shape is conventional, and facilitates the formation of conductive bumps on the pad at a subsequent stage in processing as will be discussed later.

Detailed Description Text - DETX (18):

Thus, it is apparent that there has been provided in accordance with the present invention a bumped semiconductor device and method for probing the same that fully meets the needs and advantages set forth previously. Although the invention has been described and illustrated with reference

to specific embodiments thereof, it is not intended that the invention be limited to these illustrative embodiments. Those skilled in the art will recognize that modifications and variations can be made without departing from the spirit of the invention. For example, the present invention is not limited to use with any particular type of semiconductor die or type of integrated circuitry. In addition, the invention is not limited to the specific materials and processing techniques mentioned in the foregoing description. In particular, the invention is not limited to bumped semiconductor device having C4 bumps. The invention is applicable to any type or bumped for flip-chip device. It is also important to note that while emphasis has been placed on the proximity of test pads to underlying bond pad positions, that such proximity is limited only by the ability or inability to use cantilever probe needles to probe the test pads. In preferred embodiments of the present invention, it is anticipated that the maximum displacement between a test pad edge and a bond pad edge will be on the order of less than or equal to 10 mils (0.215 mm). This range of displacement does not include displacement of test pad edges formed within the bond pad boundaries. Therefore, it is intended that this invention encompass all such variations and modification as fall within the scope of the appended claims.

Claims Text - CLTX (10) :

4. The device of claim 1 wherein the plurality of bond pads comprises a first bond pad having an edge, wherein the plurality of test pads comprises a first test pad which corresponds with and overlies the first bond pad, the first test pad having an edge which corresponds with the

edge of the first bond pad, and wherein a displacement distance between the edge of the first bond pad and the edge of the first t st pad is less than approximately 0.25 mm.

Claims Text - CLTX (24):

9. The device of claim 8 wherein the test pad overlies and at least partially overlaps the bond pad.

Claims Text - CLTX (29):

14. The device of claim 8 wherein the bond pad is formed from a first metal layer and the test pad, the bump pad, and the metal interconnect are formed from a second metal layer.

Claims Text - CLTX (37):

a test pad electrically connected to the associated bond pad;